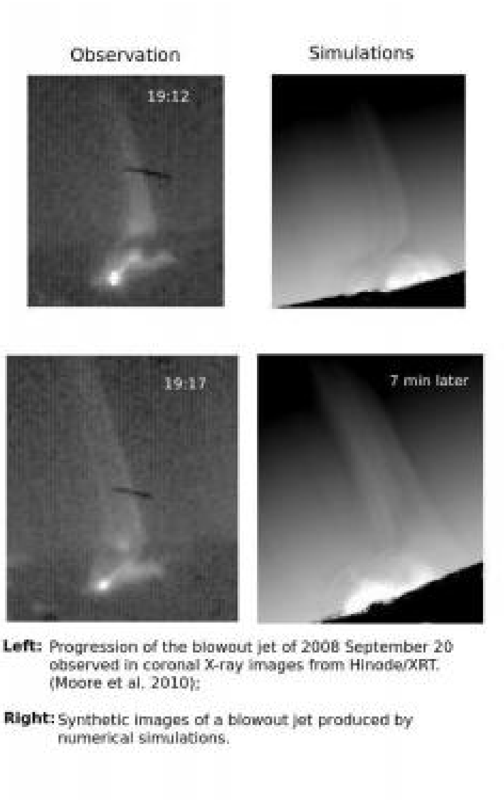
Big solar blowouts hold clue to space weather

23 June 2014, by Robert Massey



A montage of images showing how the simulation closely matches observed events on the Sun. On the left are two images of the blowout jet eruption of 20 September 2008 observed using the Hinode observatory, showing how it changed over a period of five minutes. On the right are two frames from Eon Jui Lee's simulation of a blowout jet eruption. Credit: Hinode / Eon Jui Lee / University of St Andrews

(Phys.org) —Solar jets are ejections from the surface of the Sun, where 1-10 tonnes of hot material are expelled at speeds of up to 1000 kilometres per second. Using space based observatories like Hinode and STEREO, solar physicists have recently discovered a new type of jet known as 'blowout' jets, which seem to be like the Coronal Mass Ejections (CMEs) that can disrupt the magnetic field of the Earth, but on a much smaller scale.

Now a St Andrews scientist, Dr Eon Jui Lee, has created a 3D model of these events for the first time, with compelling computer-generated simulations that match the jets' appearance from space. He will present his work at the National Astronomy Meeting (NAM 2014) in Portsmouth from 23-26 June.

The most common class of 'hot' solar jets are the 'standard' X-ray jets, which are believed to be formed by 'magnetic reconnection' i.e. when magnetic field lines of opposite direction ('north' and 'south') come into contact. Blowout jets are different and seem to be triggered by the eruption of the magnetic field at the base of the jet, which carries a twisted filament of material. At a temperature of 10,000 – 100,000 degrees Celsius, this is much cooler than the outer atmosphere of the Sun, where temperatures are typically between 1 and 2 million degrees.

On the Sun material is found in the form of plasma, a gaseous state where some electrons are stripped away from normally neutral atoms. In blowout jets, the eruption of relatively cool plasma leads to magnetic reconnection too and this in turn drives the eruption of hot plasma, so that both hot and cold material are carried into space. This makes them like miniature CMEs and suggests that a similar mechanism is at work.

Dr Lee's model shows the change from standard to blowout jets and frames from the simulation show a close fit between his work and pictures from the Hinode satellite. The model suggests that the twisted magnetic fields in standard jets become helical and drive the blowouts. Waves in the jet then transport material and energy into the outer atmosphere of the Sun and the wider Solar System.

He comments: "Solar physicists work hard to understand activity on the surface and in the atmosphere of the Sun. To see my simulations match real observations so well is wonderful. I hope that this work will help my peers working on space weather better understand and perhaps get more warning of events that might disrupt life on Earth."

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